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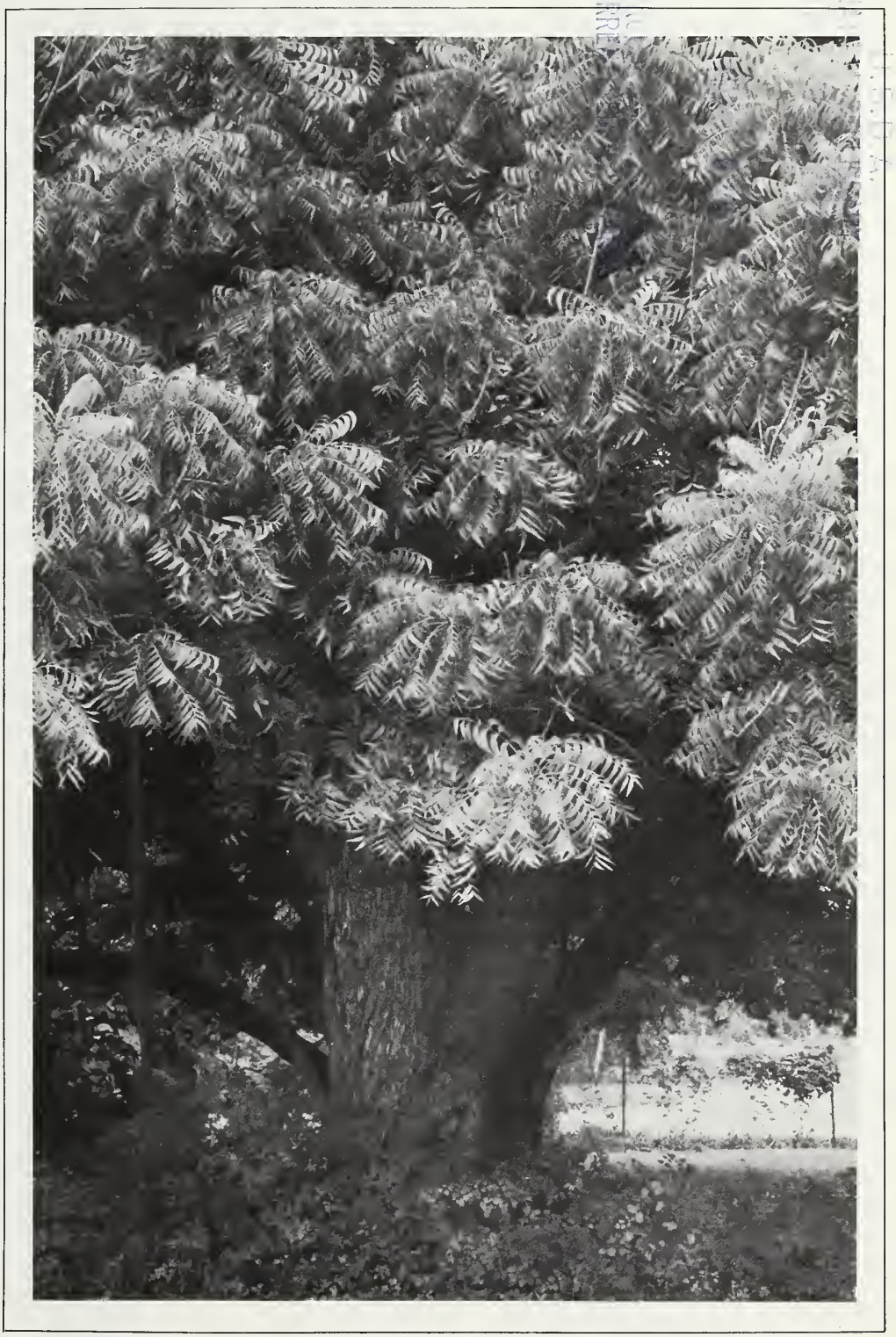

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Soil Erosion—A Silent Foe

The problem of soil erosion, the subject of this column last month, is as deceiving as it is universal. The erosion process is deceptively slow, and so the land changes imperceptively. Yet soil erosion continues everywhere, silently depleting the soil, silently adding to non-point source pollution, silently remaining in the background—away from the spotlight of current national concern.

However damaging erosion has been to American agriculture, it has not received as much notice outside the agricultural sector as have other problems. Still, much work is being done—both with erosion and non-point source pollution.

One of the questions researchers are now asking is "Exactly what effect does soil erosion have in areas where topsoil is plentiful?" One answer lies in the pollution of inland waterways. What about the effect on the crops themselves? The obvious answer, in an area where topsoil is 5- to 10-feet thick, is little or none. But answers to questions on a subject as complex as soil erosion are frequently not obvious.

Within SEA, Agricultural Research scientists are working to develop methods to combat erosion and non-point source pollution from agriculture; many others—communicators, teachers, and Extension specialists—are working to disseminate information to people in all facets of agriculture. Two recent accomplishments are the reports "Predicting Rainfall Erosion Losses" and "Control of Water Pollution From Cropland." The first, on soil erosion by water, is a detailed guide for using the Universal Soil Loss Equation. The second, in two volumes, contains information on the control of water erosion from agricultural land. This report reflects current knowledge of water pollution and erosion, and was designed to help in developing guidelines for meeting Public Law 208 requirements.

Minimum tillage systems are one of agriculture's most effective means of combating soil erosion. But there are important trade-offs: in some areas, the need for pesticides increases with minimum till systems. Minimum tillage causes the soil to warm up more slowly in the spring. This can cause farmers to delay their first planting which, in turn, can mean a reduction in yields. Also, the excessive amount of residue frequently results in poor stands.

Much work is going on. But even with the efforts of the agricultural sector and advances made by SEA scientists and others, the problem still is too little known—too little considered outside of those concerned about agricultural and environmental matters. And this may be the greatest problem of all. The challenge of soil erosion can not be effectively solved until more of those dependent on American agriculture become concerned.

And that means practically all of us.—*Robert W. Deimel*

***Editor:** Patricia Loudon*

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COVER: The East Indian neem tree has been enlisted in the fight against Japanese beetles, one of our most persistent and costly insect pests. SEA researchers have discovered that the seed-extract from this rare tree (only two grow in the United States) protects crops from the ravages of the destructive beetle. Story begins on page 8 (1178X1571–5).

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Bob S. Bergland, Secretary
U.S. Department of Agriculture

Anson R. Bertrand, Director of
Science and Education

Charles W. (Bill) Fitzgibbon (left) and Dr. Replogle inspect a prefabricated concrete ramp prior to installation. The ramp's underside is cast hollow to conserve weight, as is the underside of the already installed sill block against which the ramp block will rest. Fitzgibbon is superintendent of the University of Arizona Cotton Research Center farm, Phoenix, where some of the flume experiments have been conducted (1278X1631–35).

Ahead . . . More Efficient Irrigation

A SIMPLE, low-cost, easy-to-install measuring flume has been developed that should aid ditch irrigators meter precise amounts of water to fields.

This flume which costs less than $100 is designed for concrete-lined canals and is accurate to plus or minus 2 percent with less "head loss" than more complex flumes costing as much as $1,000

Farmers and ranchers should have little trouble installing the flumes once they have the specifications and a short course from their Soil Conservation Service (SCS) engineer.

Some irrigators have shied away from installing the more complex models because of their expense. Besides, the irrigators didn't want to operate with what they thought was too much head loss.

Above: *The poured-in-place concrete sill and ramp style of flume. Small pipes shown at base of sill allow for drain-down to eliminate standing water for mosquito control. Dr. Replogle indicates that both sill height and width can be constructed to accommodate a variety of ditch sizes and low rates (1278X1633–3A).*

Right: *Using surveying methods, Dr. Replogle positions the easy-to-read gauge at the proper height on the canal wall. Fitzgibbon assists. The wall gauge is placed about 1 foot upstream from the end of the flume ramp and can be marked to be read directly in preselected discharge units, without the need of calibration tables (1278X1631–11).*

Modern day irrigation is a science. Irrigators who water crops from canals must have the same control as those irrigating from sprinklers, trickle systems and the like. They can no longer guess.

Too little water and the crop suffers. Too much and fertilizer, water, and energy are wasted. Also, too much water in runoff or that portion leaching to the water table can create salinity pollution problems.

Those operators who do not use flumes or some similar device most often "guess" the amount of water going on fields, a poor substitute for "knowing."

Before the recent simplification, flumes had from 6 to 12 plane surfaces plus some curves. Those flumes almost defied mathematical calibration. They were generally built in a laboratory shop, calibrated by running water through them, and then duplicated for field applications. A long, laborious, and costly undertaking.

That condition exists no longer.

SEA hydraulic engineer John A. Replogle, Phoenix, Ariz., devised a computer program that permits long-throated flumes of almost any cross-sectional shape to be quickly calibrated on a computer—no field calibration is necessary.

From that computer program evolved the simplification that permits accurate flumes to be built requiring only one smooth flat surface.

Now, a simple flume can be built by pouring concrete on the bottom of the canal to form a small dam or broad crested weir. The essential part is the "flat smooth surface" on top of the dam. That sill is from 1 to 4 feet (30.5 cm to 122 cm) long depending upon the canal size. The dam causes a needed rise in the water upstream—called critical flow by engineers. A gauge, mounted permanently on the side of the canal upstream from the dam, directly indicates the amount of water passing through the canal and over the sill.

A short ramp is included in the construction to guide the water over the sill evenly and also permits sediment to be carried over the top to keep the canal free of debris. Small pipes are imbedded in the bottom of the dam and ramp to drain the ditch when not in use to help control mosquitoes.

Dr. Replogle's computer program won him the coveted Croese medal last year from the American Society of Civil Engineers.

After getting details from Dr. Replogle or from a Soil Conservation Service engineer (there is a bulletin on the flume in preparation), all that's needed by irrigators to build the flume is plywood and wire for forms, a few lengths of plastic pipe, concrete, and a gauge to read depth.

A portable sheet metal version of the structure has also been developed by Dr. Replogle and hydraulic engineer Bert Clemmens. It allows for temporary metering of water and as a calibration tool for SCS engineers aiding irrigators to determine the size of permanent flumes. Further information on precomputed calibrations for a variety of ditch sizes is now available from Dr. Replogle.

Replogle and Clemmens are stationed at the U.S. Water Conservation Laboratory, Phoenix, AZ 85040.—*J.P.D.*

Right: *Design and calibration of long-throated flumes is easily accomplished using computer programs developed by Dr. Replogle. Any practical shape and size (rectangular, triangular, trapezoidal, or complex) can be accurately computed (1278X1633–30).*

Below: *Clemmens (left) and Dr. Replogle observe water flow over a newly installed broad-crested weir style of flume. The flume has been built by Arizona's Salt River Project utilizing Replogle's computer program and design procedures (1278X1634–29).*

High Protein and Fiber Diets May Affect Mineral Metabolism

INCREASING protein in a diet may augment the body's requirement for zinc, and increasing either protein or fiber may raise the need for calcium. These are insights scientists gained from observing mineral absorption by human volunteers who consumed a high-protein or high-fiber diet for 30 days.

In the studies, still in progress at USDA's Human Nutrition Laboratory, Grand Forks, N. Dak., live-in volunteers retained more zinc from a high-protein diet than they retained from a low-protein diet. Apparently, persons on the high-protein diet required more zinc, says SEA medical officer Harold H. Sandstead who directs the research.

What is the significance of these findings? Dr. Sandstead isn't sure just yet, but he says they may have implications for elderly people in Western society. If the elderly are consuming high-protein diets made up largely of foods from which zinc is poorly available, many instances of minor zinc deficiency may exist. However, nutritionists will be hampered in prescribing dietary changes until research provides information on the bioavailability of zinc from a wide variety of foods.

Some of the research at the Human Nutrition Laboratory is directed at making bioavailability measurements on numerous foods a less formidable task than it has seemed until now. Bioavailability is the extent to which a nu-

trient can be digested, absorbed and used by animals or humans.

Because of limited income and poor dentures, many of the elderly may consume diets rich in vegetables, cereals and protein dairy products but scanty in meat, says Dr. Sandstead. Nutritionists generally believe that meat contains greater amounts of bioavailable zinc than these other foods.

Dr. Sandstead says that if further research substantiates the view regarding the bioavailability of zinc and his initial finding that high-protein diets increase the requirement of zinc, consideration should be given to zinc enrichment of inexpensive foods. Or, he suggests encouraging greater consumption of inexpensive meat and meat products by the elderly and others at risk of mild zinc deficiency.

Zinc deficiency should be avoided because it can lead to a decreased sense of taste, loss of appetite, poor healing of wounds, and increased susceptibility to infections.

For persons whose lifestyles include diets that are liberal in meat and high-fiber foods but low in dairy products, Dr. Sandstead's research may provide another instructive note. Volunteers who consumed this type of high-protein, high-fiber diet apparently required considerably more calcium than volunteers who were fed a high-protein control diet that was low in fiber. Volunteers who consumed the high-protein control diet also required more calcium than those who ate the low-protein control diet. Calcium requirement, therefore, was influenced by both the protein content and fiber content of the diets.

Calcium deficiency, some researchers have suggested, in time may lead to osteoporosis, a disease in which bones are more susceptible than normal to fracture.

Dr. Sandstead notes that instances of severe calcium and zinc deficiencies are uncommon in countries where diets are generally low in protein, even though they also may be low in zinc and calcium by conventional standards.

In the Grand Forks study, volunteers were fed high-protein diets in which about 70 percent of the protein came from animal sources. In low-protein diets, about 40 percent of the protein came from animals. About 16 percent and 8 percent of the energy in these respective diets were provided by protein.

Volunteers on high-protein diets appeared to require about 75 percent more zinc and 31 percent more calcium for their bodies' equilibrium than did volunteers on the low-protein diets. Volunteers on high-protein, high-fiber diets required about 17 percent more calcium than volunteers on a high-protein, low-fiber diet.

To test the effects of dietary fiber on the body's mineral requirements, Dr. Sandstead and his research team allotted to the volunteers rations of bread that contained about 26 grams (nearly 1 ounce) more fiber-rich material than was contained in the bread of low-fiber diets.

The breads were baked at the Spring and Durum Wheat Quality Laboratory, Fargo, N. Dak., administered by the agricultural research unit of SEA. Fiber-rich materials that Fargo researchers baked into the breads included soft white wheat bran, hard red spring wheat bran, corn bran, finely ground soybean hulls, textured vegetable protein, apple powder, or carrot powder.

The fiber study is continuing. "More data is needed before we can determine whether one fiber source differs appreciably from another in its effects on mineral metabolism," Dr. Sandstead says.

The scientists studied the effects of dietary fiber and protein on the body's requirements for several other minerals besides zinc and calcium. These minerals included iron, copper, magnesium, and phosphorus. Only calcium requirements were definitely affected by the fiber, said Dr. Sandstead. High-protein diets, on the other hand, increased the requirement for phosphorus by 55 percent, but only slightly increased the copper requirement.

"We're not greatly concerned about protein increasing phosphorus requirements because human diets generally are very rich in phosphates," Dr. Sandstead says.

But copper is another matter. A research team member, medical officer Leslie M. Klevay, has found that many diets consumed in the United States contain less than 1 milligram (mg) of copper. The National Academy of Sciences-National Research Council has suggested that adults should consume diets containing about 2 mg per day to meet their requirements.

Most nutrition tables provide dietitians with inadequate information on the amount of copper in foods, says Dr. Sandstead. "Consequently, the best advice we can give today on how to assure an adequate intake of copper is to include liver, nuts, and seeds in the diet on a regular basis."

Dr. Harold H. Sandstead is with the Human Nutrition Research Laboratory, 2420 Second Avenue North, Grand Forks, ND 58201.—*G.B.H.*

Neem Tree

Seed Extracts Repel Japanese Beetles

As adults, Japanese beetles infest more than 300 species of trees, vegetables, flowers, and fruits. Besides feeding on leaves, they often mass on ripening fruit, feeding until nothing edible is left (0874X1457–3A). Effectiveness of the neem seed extract in deterring the feeding of Japanese beetles on soybean leaves is graphically demonstrated. Extract was placed on this leaf to spell out the letters "NM". Beetles ate around the applied extract leaving the "protected letters" amidst the destroyed leaf issues (PN–4174).

JAPANESE beetles will starve before they will eat some plants treated with extracts of the seed from the East Indian neem tree. Three years of research at Wooster, Ohio, has shown good protection of soybean plants by spraying with neem seed extracts.

"Seeds of the tree have long been reputed to repel insects and deter them from feeding," says Thyril L. Ladd, entomologist and research leader of SEA's Japanese Beetle Research Laboratory at Wooster. "So, we decided to examine extracts of the seeds to determine whether they affect feeding of Japanese beetles."

Japanese beetles are known to feed on about 300 different plants including grapes, roses, birch, elm, rhubarb, and even poison ivy. The grub stage lives in the soil and loves good turf, where it

consumes the roots, reducing growth and even killing the grass in severe cases. Turf is especially susceptible to beetle damage in dry weather, Dr. Ladd says.

The beetles are slowly spreading from their present range which runs from southeastern Canada to Georgia and from Delaware to Missouri.

Using sassafras foliage as the test material, SEA scientists tried three different extracts from the neem seed in 1975. They tested five concentrations of each extract, ranging from 0.25 to 10 percent, which were applied to one-half of the leaf. The leaves were then placed in containers with 25 beetles. In an additional test, entire leaves were treated and placed in pots without a supply of untreated leaves for the beetles.

"When leaves were checked 24 to 48 hours later, the treatment showed excellent results," Dr. Ladd said. Untreated leaf halves were completely consumed except for veins. Treated leaf halves were practically untouched. Only the leaves receiving the lowest concentrations showed slight indications of feeding.

"When beetles were offered only treated leaves, we found occasional small scars on the leaf surfaces," Dr. Ladd said. "Some beetles died rather than consume the treated sassafras leaves."

Because of the successful results, both laboratory and field tests were conducted in 1976 using soybeans. The tests were designed to evaluate the residual effects of the neem seed extracts on beetle feeding.

Beeson variety soybeans were sprayed in the field and leaves were picked and placed in pots in the laboratory with 40 beetles at various intervals over a 17-day period. The leaves were checked for damage after 24 hours.

Beetles rapidly destroyed untreated foliage, Dr. Ladd said, while neem-treated leaflets collected 3 days after treatment remained undamaged. Those collected 12 days after treatment suffered only slight damage, and those tested at 17 days showed only moderate feeding.

Other treated plants were left in the field and checked for damage. Repellency was still protecting the plants 14 days after treatment in the midst of heavily damaged, untreated soybean plants, Dr. Ladd said.

In 1977, the third year of tests, randomly selected plants were treated in the field on a 3- or 7-day schedule. Baits were used to attract beetles to the area. Beetle counts were made on the plants each day and feeding damage was evaluated at the end of the test.

The differences in feeding on neem-treated plants and untreated plants were striking, Dr. Ladd said. Thirty-six times as many beetles were counted on

Neem seed, left, and powdered (1278X1642–12).

untreated plants as were found on those sprayed on the 3-day schedule with neem extract. Part of the test had to be terminated after 9 days even though plants treated on the 3-day schedule were relatively untouched because the untreated plants were destroyed.

"Our studies show that extracts of neem seeds are uniquely effective as a deterrent to Japanese beetle feeding," Dr. Ladd said. "Since other research has shown these extracts to deter other insect pests, they may be useful in a number of pest management systems."

"We are looking at a variety of approaches to the Japanese beetle problem," Dr. Ladd said. "The neem seed extract looks good so far. It is a natural material and, hopefully, should not be a hazard to the environment."

Research chemist Martin Jacobson, chief of USDA's Biologically Active Natural Products Laboratory, Beltsville, Md., cooperated with Dr. Ladd on the project. Research technician Charles R. Buriff also worked with Dr. Ladd at Wooster. The Beltsville laboratory is continuing its cooperation by isolating the active compounds and providing these to Dr. Ladd for evaluation.

Jacobson says the neem tree is a commercially grown crop in India where the seed oil is used in medications and as fuel in lamps, as well as for repelling insects. For example, in India, the seeds are commonly mixed with grain in storage to keep insects out.

Dr. Thyril L. Ladd, Jr., is with the Japanese Beetle Laboratory, Ohio Agricultural Research and Development Center, Wooster, OH 44691.—*R.G.P.*

Dr. Jacobson observes the now compound-laden solvent that has been placed in an evaporator, under low pressure, allowing the vapors to rise through a condensor. After recovery, the solvent-free extract will be subject to column and liquid chromatography for isolation of active compounds. This material will be sent to Dr. Ladd in Wooster for field testing (1278X1642–9A).

***Left:** In the first step to extract the beetle-repelling compounds, chemist Edward C. Uebel has placed ground neem seed in paper filters where heated organic solvents will percolate through (1278X1624–34).*

Oat Bran Bread Pleases Palates

TASTE testers found that oat-bran bread pleased their palates more than did bread made from wheat bran. But what the persons participating in the tests didn't know was that the high-fiber bread made from oat bran was rich in protein including the essential, but often scarce, amino acid lysine.

As good as oat bran may be, it's not perfect. In their research, SEA chemist Vernon L. Youngs, Madison, Wis., and North Dakota State University cereal chemist Bert L. D'Appolonia, Fargo, found that loaf volume of the oat product was less than the volume of wheat-bran bread. Bakers can increase loaf volume, however, by including sodium stearoyl-2-lactylate (SSL) in the baking formula. SSL is a commonly used additive that improves overall bread baking characteristics.

Youngs and D'Appolonia reduced the amount of wheat flour in a bread formula and substituted both oat and wheat brans or oat protein concentrates. Breads containing up to 20 percent oat bran in oat bran-wheat flour blends were preferred over wheat-bran bread by taste panelists in their comparisons of chewiness, taste, and aroma. Panelists liked oat-bran bread and white bread from Hard Red Spring wheat flour about the same, but they gave oat-bran bread a slight edge for chewiness.

Bread in which 10 percent of the flour was replaced by oat-protein concentrate was similar to oat bran in acceptability by panelists, but the stability with which this bread held its volume in baking was poorer than the stability of oat-brand bread. Adding SSL to the formula increased volume of loaves from 775 cubic centimeters (cc) to 820 cc. By comparison, white bread with SSL took up a volume of 960 cc, Youngs said.

Removing most of the fat from oat-protein concentrate decreased both loaf volume and taste panelists' preference ratings.

The scientists used protein concentrates that were obtained through milling, slurrying, and centrifuging oats and oat fractions, a procedure that Youngs developed in cooperation with the Wisconsin Agricultural Experiment Station several years ago. The concentrates contained about 50 percent protein.

Protein concentrations of various oat brans used in the study ranged from 20 to 23 percent, Youngs said. Some 3.8 to 4.2 percent of the protein was made up of the amino acid lysine.

Proteins of most other cereals lack sufficient lysine for good nutrition. Lysine is one of the essential amino acids that must be supplied in diets because the human body cannot make enough for its needs.

The potential use of oat bran in baked goods is enhanced by development of new high-protein varieties of oats that farmers are now growing, Youngs says. As oat breeders have concentrated efforts to increase protein in oat groats (oats without hulls), protein content of bran has also increased.

Also, new technology for separating groats into bran, protein, and starch fractions may strengthen a trend in making oats into foods for direct consumption by humans rather than into feeds for livestock, the agricultural researcher said.

Youngs and his colleagues at the University of Wisconsin and the University of Arkansas have conducted studies that show farmers' cultural practices may enhance nutritional qualities of oat bran. Oats that were fertilized heavily with nitrogen produced extra protein, and more of the extra protein was in the bran than in the germ or endosperm.

Dr. Vernon L. Youngs is with USDA–SEA, Department of Agronomy, University of Wisconsin, Madison, WI 53706.—*G.B.H.*

Fingerprinting Plants

"Some day scanning electron micrographs may be part of plant patent applications supplementing the traditional morphological descriptions of the plant's form and structure," says Charles R. Krause, SEA plant pathologist.

Dr. Krause found that the scanning electron microscope, which produces a three-dimensional image of a specimen on a TV screen magnified up to 200,000 times, shows leaf characteristics clearly enough to identify a specific cultivar. A cultivar is a group of plants produced vegetatively from a single plant.

Dr. Krause was able to identify American elm cultivars, grown from cuttings, with the original source trees by this "fingerprinting" method.

Three-year-old elms, started from cuttings from two different source trees, were grown in the greenhouse and outdoors. Leaf samples were collected monthly through the growing season from the cultivars and fingerprinted against leaf samples collected from the source trees.

To prepare the leaf samples so that they maintain their life-like condition, Dr. Krause goes through several complicated steps. He finishes by coating the samples with gold to provide the most accurate image under the scanning electron microscope.

The resulting images show consistent differences in the appearance of stomate (openings in the leaves) and trichomes (leaf hairs) between the two test groups. This is true even at low magnification of 100 times actual size, Dr. Krause says.

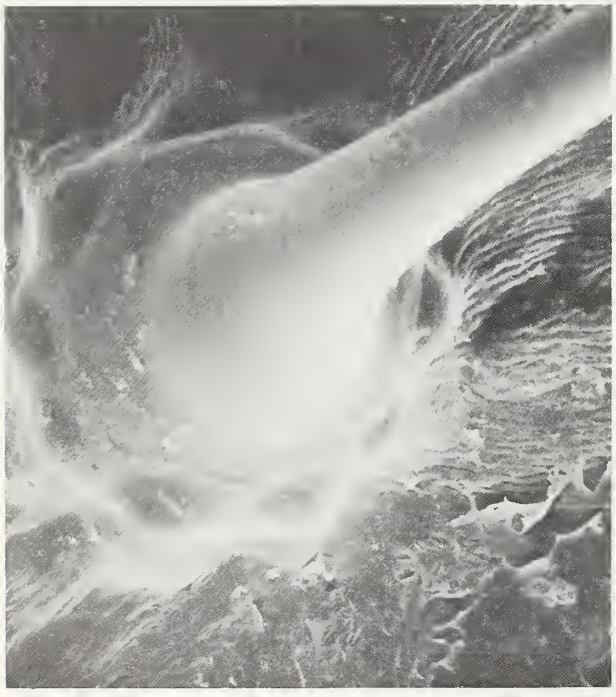
"Shapes and numbers of trichomes as well as shapes and sizes of stomata provide major differences in appearance. Identification of specific elm cultivars can clearly be made by these differences," Dr. Krause says.

The scanning electron microscope method of distinguishing between cultivars requires less than 2 days. Other methods have been used successfully, but they require several days and considerably more laboratory work.

Dr. Krause is now trying to establish "fingerprints" for maple, rose, and cultivars of other plants. The project is funded in part by the Horticultural Research Institute.

Dr. Charles R. Krause is with the Nursery Crops Research Laboratory, Delaware, OH 43015.—*R.G.P.*

Magnified 1000X through scanning electron miscroscopy (SEM), subtle differences in simple trichomes (leaf hairs) of elm clones from a single parent provide positive identification never before possible. Basal cells of the leaf hair below left are arranged in stellulate (minute star-shape) configuration. In contrast the SEM photo below right is non-stellulate in form.



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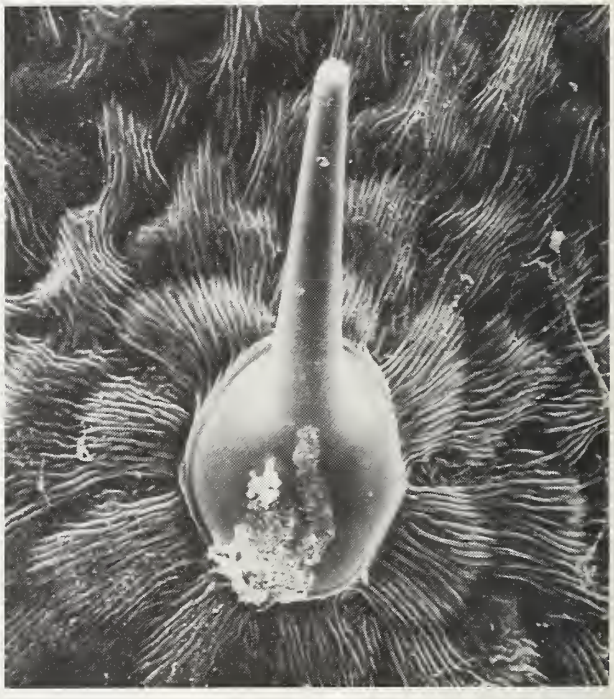

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PN–4180

Higher magnification (2000X on a 4x5 image) reveals that stomatal size and configuration varied between clones. The photograph above left shows a stomatal in which layers of wax were readily visible within the stomatal aperture, increasing its apparent size. Conversely, the stomatal aperture in the photograph above right is partially closed due to a waxy coating.

SEM examination also reveals differences in glandular trichomes from a single parent. The leaf hair below left has bulbous head evidenced in this highly magnified photo. The photo below right is from another clone and is characteristically long and narrow.

PN–4178

PN–4177

Aiding Revegetation in Stripmining

ESTABLISHMENT of native grasses for reclaiming stripmined areas is often difficult because of lack of seed, damage by animals and insects, and limited soil water. A method to aid revegetation has been evaluated by SEA researchers in Wyoming.

Topsoil contains seeds, rhizomes (underground roots that send up shoots), and other vegetative plant parts from the native plant community. These plants and plant pieces contained in topsoil removed from undisturbed areas and directly placed over regraded mine spoils can begin growth at their new location, thus aiding revegetation of the area.

Such a practice would assist in the overall reclamation process. As one area is exhausted of the mined coal or uranium, another area just being opened up could provide topsoil. Topsoil is currently stockpiled for later replacement over the area from which it was removed. During this time many of the desirable plants dry out and die.

After two growing seasons with only natural precipitation (no irrigation), an average of 5 plants per square yard survived near Kemmerer, Wyo., and 2 plants per square yard near Oak Creek, Colo.

"This plant density is much too low to meet state and federal revegetation standards. But it is a start in helping to give more species diversity to the reclaimed area after reseeding," says SEA horticulturist Gene S. Howard.

Grass density was greater in Wyoming than in Colorado probably because western wheatgrass predominates and reproduces by rhizomes as well as by seed. Perennial herbs such as englemann aster and common yarrow were denser in Wyoming than in Colorado, but woody shrubs were approximately the same.

"The lower plant density in Colorado compared to that in Wyoming, may result because it is a totally different plant community which does not respond as well to this technique," says SEA botanist Marilyn J. Samuel.

Topsoil near Kemmerer came from a big sagebrush plant community that contained western wheatgrass, slender wheatgrass, big sagebrush, fourwing saltbrush, and Indian ricegrass. Annual precipitation averages less than 9 inches.

Topsoil near Oak Creek came from a mixed-shrub plant community that contained saskatoon serviceberry, gambels oak, quaking aspen, big sagebrush, snowberry, chokecherry, and mountain brome grass. Average annual precipitation as recorded at the nearest measuring station was about 16 inches.

Topsoil depth averaged about 7½ inches at the two locations.

Gene S. Howard and Marilyn J. Samuel are both located at the High Plains Grasslands Research Station, Rt. 1, Box 698, Cheyenne, WY 82001.—*D.H.S.*

AGRISEARCH NOTES

Tiny Plants Show Water Quality

EXTREMELY tiny water plants—called diatoms—can be excellent indicators of water quality. Diatoms are single-celled plants that have a silica cell wall.

They are in the class of algae, Bacillariothycea, and are universally found in aquatic environments such as on rocks at the seashore or in a creek bed.

Farm ponds are important for irrigation, livestock watering, and recreation. Since the chemical, physical, and biological makeup of the water can be altered by runoff containing soil, fertilizers, and pesticides, it is important to have a tool for measuring water quality.

Diatoms can serve this purpose. Studying the diatom communities of two experimental and two farm ponds, SEA botanist William W. Troeger found that the tiny plants respond very quickly to changes in water quality. Since diatoms are widely distributed in lakes, ponds, oceans, and rivers, and since they respond quickly to the differing physical and chemical conditions of bodies of water, variations in the communities of the diatoms can be used as a good indication of water quality.

Different species of diatoms can be accurately identified by their wall structure, and the cost of equipment for sampling and testing the water is low. The major mineral requirements for diatom communities are phosphate, nitrogen, sulfate, calcium, magnesium, potassium, iron, manganese, and silicon. They also respond to the temperature, turbidity, and alkalinity or acidity of the water.

In his study of the four ponds, Troeger found that the two farm ponds supported a more diverse population of diatoms than did the two experimental ponds, possibly because of their greater age and larger size.

William W. Troeger is located at the Water Quality Management Laboratory, 801 Wilson Street, Durant, OK 74701.—*B.D.C.*

When Mosquitoes Go to Lunch

IN PLACE of potato salad, picnickers often become the picnic. Of course mosquitoes are looking for a blood meal, but what attracts them in the first place?

Scientists say that attractants may include (singly or in combination) odors, moisture, visual factors, warmth, carbon dioxide, and lactic acid coming from human skin.

SEA and University of Florida scientists contend that mosquitoes respond to a hierarchy of stimuli that seem to overlap. In experiments with laboratory-raised mosquitoes which are potential vectors of malaria, human skin odors were collected from an arm box, held in one of three giant Teflon bags, and shown to be attractive.

The arm box is a glass cone large enough to accommodate a human hand and forearm closed in by a rubber sleeve. The apparatus permits injection of air containing emissions from the person's skin into one port and clean air into the other port of a dual-port olfactometer. Researchers then monitor and balance the two flows for air speed, differences in temperature, relative humidity, and carbon dioxide level. The olfactometer measures mosquito response to airborne odors.

Approximately 60 of 100 female mosquitoes were attracted into a trap by air which was passed over an arm and injected into the olfactometer during a 3-minute test. The same air could be held in a 150-liter Teflon bag for an hour and still trap 40 percent of the mosquitoes, while clean air from a clean bag attracted no mosquitoes.

The scientists believe that with these bioassays they have "at least simplified the mosquito attraction hierarchy." All clues associated with the host's presence were removed—seeing the host, sensing his infra-red emissions, and/or sensing the warm air rising in convection currents from his body. Since carbon dioxide and water were added to balance the airstream, the female mosquitoes could respond only to human-produced organic chemicals which attracted them up the airstream into a small trap.

The research was partly funded by the Medical Research and Development Command, Office of the Surgeon General, U.S. Army. Such information can be especially useful in developing repellents for mosquitoes attacking military troops in the field.

Scientists who are attempting to identify the human-produced organic chemicals which attract mosquitoes are chemist George D. Price at the University of Florida, and entomologist Nelson Smith and chemist David A. Carlson at the Insects Affecting Man and Animals Research Laboratory, P.O. Box 14565, Gainesville, FL 32601.—*P.L.G.*

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Bacterial Leaf Blight May Threaten Rice

ALL MAJOR U.S. long-grain rice varieties, and most medium- or short-grain varieties are highly susceptible to bacterial leaf blight (BLB) disease. Few of the varieties and lines used in crosses in U.S. breeding programs in recent years had usable resistance when screened in tests conducted in countries where the disease is prevalent.

Researchers first submitted varieties and breeding lines for testing in 1975 to cooperators D. M. Tantera of the Central Research Institute for Agriculture, Bogor, Indonesia, and H. Weeraratne of the Centro Internacional de Agricultura Tropical in Colombia, South America. The varieties and lines were transplanted into the field and inoculated with the disease. Of the varieties submitted, Calrose, Calrose 76, IR–22, IR–26, Mars, Pelita I–1, Reimei, Tangin Bozu, and Zenith showed the best levels of resistance to BLB.

Although the disease has not been observed in the United States to date, recent reports of BLB in Mexico and in Central and South America underscore the need for measures to prevent its introduction. A. J. Oakes of the SEA Plant Genetics and Germplasm Institute in Beltsville, Md., who processes rice and other field crop accessions, stresses the need for strict adherence to established quarantine regulations by anyone considering seed transfers into the United States regardless of the amount of seed involved.

There is a further need to identify sources of resistance and to use them in U.S. rice breeding programs. According to M. C. Rush, rice pathologist, and B. J. Hoff, agronomist, of Louisiana State University, Baton Rouge, La, and W. O. McIlrath, SEA agronomist, Crowley, La., efforts are already being made to incorporate BLB resistance into improved varieties at the Stuttgart, Ark., Crowley, La., and Beaumont, Tex., rice stations where U.S. rice breeding programs are conducted. Cooperative efforts to locate additional sources of resistance are also being continued.

Dr. William O. McIlrath is with the Rice Experiment Station, Louisiana State University, P.O. Box 1429, Crowley, LA 70526.—*E.L.*

Counting Eggs to Improve Cotton

A SCIENTIST has developed a new, precise technique for finding plants with the greatest resistance to the cotton root-knot nematode, a serious economic pest of cotton.

"Especially important," says research agronomist Raymond L. Shepherd, "is that we can now measure not only resistance to root galling, but also the egg-laying ability of the parasitic nematodes."

Scientists have previously looked primarily to root galling as an indicator of a cotton plant's resistance to the nematode and paid little attention to the nematode eggs. When scientists did consider nematode eggs in the past, their method was simply visual estimates.

Shepherd found that there was considerable variation in egg production even among cotton lines that galled at similar rates. Moreover, he developed a technique that allows for a quantitative evaluation rather than a subjective estimate.

The technique consists of several steps, but a crucial part is chemically washing eggs from egg masses located on cotton plant roots, collecting the eggs on a fine mesh sieve, and counting them with the aid of a microscope.

The researcher found one resistant cotton line (Auburn 623 RNR) that had only 500 eggs per plant after being exposed to a population of several thousand nematodes per plant for 40 days. This compares to 120,000 eggs per plant found on a susceptible line (M–8), a quite dramatic difference.

Most of the cotton planted worldwide is susceptible to some degree to the nematode. Using Shepherd's technique, scientists can now find plants with extremely high resistance to nematode egg laying. "The technique," says Shepherd, "gives us high potential for breeding cotton varieties capable of preventing economic damage from the cotton root-knot nematode."

Shepherd is with the SEA Crop Science Research Unit located at Auburn University, Auburn, AL 36830.—*B.D.C.*

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